Marketability and Nutritional Qualities of Some Edible Forest Insects in Benue State, Nigeria

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Abstract: This study investigated the marketability and nutritional qualities of four edible insect species in Benue State. Using market survey checklists, 10 out of the 23 Local Government Areas and three major towns of Benue State were covered for data collection. Proximate composition of the edible insects marketed in the study area was determined on dry weight basis. One-way ANOVA was used in analyzing the data collected. Results showed that Cirina forda Westwood had significantly the highest mean quantity per marketeer of 13.2 kg. There was no significant difference in the mean quantity per marketeer of Bunae alicinoe Cram (3.5 kg), Macrotermes natalensis Haviland (1.6 kg) and Brachytrupes membranaceus Drury (0.2 kg). The proximate composition of the selected edible insects showed that the crude protein contents of the caterpillars of the emperor moths, C. forda (74.35±0.09), B. alicinoe (74.34±0.04) were significantly highest (p<0.05), followed by M. natalensis (65.62±0.07) and then B. membranaceus (35.06±0.12).

Key words: Marketability, nutritional qualities, edible forest insects, Benue State

INTRODUCTION
The forest and its by-products, in addition to timber, firewood and charcoal, are of vital importance to the rural population. These include various vegetables and fruits, mushrooms, edible insects, medicinal plants, honey, etc (Adegbun and Bada, 2004; Akanbi and Ashiri, 2002; Latham, 2001). Non-timber forest products are important for food security, health, social and economic welfare of rural communities. They provide a significant nutritional contribution, especially crucial during times of drought and famine and create more varied, palatable and balanced diets (FAO, 1989; Ramos-Elorduy, 1997). Edible insects are a food resource that continues to be tapped extensively by populations in the Third World (De Foliart, 2002, 1990, 1989; Latham, 2001; Cherry, 1991). The pallid emperor moth, Cirina forda, which is a defoliator of shea butter tree, Vitellaria paradoxa, is a delicacy in many homes in Africa (Nongo, 2005; Akanbi and Ashiri, 2002; Odeyemi and Fasoranti, 2000; Fasoranti and Ajiboye, 1993). The larva of the moth, Bunae alicinoe, is a defoliator of many forest trees including Parkia biglobosa, Prosopis africana, Khaya senegalensis, but the insect is cherished in many homes in Nigeria (Akanbi and Ashiri, 2002). The termite, Macrotermes natalensis is a delicacy in many homes in Nigeria and throughout Africa. However, termites form the most destructive group of insect pests of tree species in Nigeria (Akanbi and Ashiri, 2002; Appiah and Asagbonhi, 2000; Fasoranti and Ajiboye, 1993; Ashiru, 1983; Agwu, 1981; Malaka, 1973). The large African cricket, Brachytrupes membranaceus, which is very much cherished in many homes in Nigeria is a pest of forest nurseries where severe defoliation may result (Akanbi and Ashiri, 2002; Hill, 1983). Where, careful studies have been conducted, the volume of insects consumed as a percentage of the total animal protein has been shown to be appreciable (Dufour, 1987). Considering the popularity of the edible insects, it is not surprising that scores of species have been and are, prominent items of commerce in the town and village markets of Africa and tropical and semi-tropical regions of the world (De Foliart, 2002, 1989). In several areas of Zimbabwe, South Africa, Zambia and Nigeria, many families make fairly good living from selling insects (Adegbun and Bada, 2004; Mbata and Chidumayo, 2003; Fasoranti and Ajiboye, 1993; Chavunduka, 1975). In South Africa for example, about 1600 tonnes of the emperor moth (mopane worm) Gonimbrasia belina (Westwood) are sold annually in the country (De Foliart, 1990; Vane-Wright, 1991). As many as 5000×50 kg bags of dry mopane worms, selling at the rate of South African Rand 120-150 per 50 kg bag were reported to have been purchased by one businessman in Botswana. It is important to note that insects are high in protein, energy and various vitamins and minerals (De Foliart, 2002, 1989). The nutritional qualities of edible insects have been studied by various authors including Ajayi and
Marketability of edible insects in Benue State: A checklist was used to survey the marketability of edible insects in the study area. Three major markets were selected in each of the 10 LGAs under study and visited three times (on 3 different market days). Using purposive sampling, five insect marketers (where possible) were interviewed at random from each market (Osalu, 1986; Anonymous, 2003). The aim of this market survey was to identify the species of edible insects offered for sale, units of measurement, cost per unit measure and the quantities of the edible insects offered for sale in each market. Data analysis was by one-way ANOVA (Akindele, 1996).

Nutritional qualities of edible insects in Benue State: Proximate analyses were carried out to determine the nutritive value (dry matter, crude protein, ether extract, crude fibre, nitrogen free extract and ash of C. forda, B. alcinoe, B. membranaceous and M. natalensis (the marketed insect species). Insect samples were collected and oven-dried at 45°C according to the procedure described by Adedire and Ayiesanmi (1999). Dried samples were pulverized with pestle in a ceramic mortar and the resulting powder used. The proximate composition was determined on dry weight basis using the procedure given by AOAC (1990). Data obtained were subjected to arcsin transformation and then to one-way Analysis of Variance (ANOVA) with mean separation done using Duncan’s Multiple Range Test (DMRT) (Akindele, 1996).

RESULTS
Marketing of edible insects in Benue State, Nigeria: Four edible insect species were offered for sale within the study period (Table 1). These were larvae of the pallid emperor moth, Cirina forda Westwood (Plate 1); larvae of the spiny emperor moth, Bunaea alcinoe Cram (Plate 2); alate forms of the termite, Macrotermes natalensis Haviland (Plate 3) and adults of the cricket, Brachytrupes membranaceous Drury (Plate 4) with Cirina forda having significantly the highest mean quantity per marketer (p<0.05). There was no significant difference in the mean quantity per marketer of Bunaea alcinoe, Macrotermes natalensis and Brachytrupes membranaceous. Edible insects were sold using spoons, milk tins and local modus or just placed in heaps with prices depending on the unit measure, the

<table>
<thead>
<tr>
<th>Type of insect</th>
<th>Mean quantity (kg) per marketer</th>
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<tbody>
<tr>
<td>Cirina forda</td>
<td>13.2±1.1*</td>
</tr>
<tr>
<td>Bunaea alcinoe</td>
<td>3.5±0.5*</td>
</tr>
<tr>
<td>Macrotermes natalensis</td>
<td>1.6±0.2*</td>
</tr>
<tr>
<td>Brachytrupes membranaceous</td>
<td>0.2±0.3*</td>
</tr>
</tbody>
</table>

*Values are mean quantity ± SEM of edible insects offered for sale in Benue State markets. Means with the same superscripts are not significantly (p>0.05) different.

MATERIALS AND METHODS
Study location: The research was conducted in Benue State which is located between latitudes 7°30'N and 8°10'N and between longitudes 7°30'E and 8°50'E. The State lies in the transition belt between the tropical rain forest of southern Nigeria and the open grassland savanna vegetation of northern Nigeria (Benue State Diary, 2007).
insect species in question and market in consideration (Plate 1-3). For example, a mudu of dried C. forda and B. alcinoa which weighed 0.8 Kg was sold for N350.00 while, a milk tin (0.1 kg) of the same product was sold for N50.00 in North Bank market in Makurdi. The same product was sold for N300.00 and N50.00, respectively in Zaki-Biam market in Ukum LGA. In many rural markets, there was no particular unit of measurement as edible insects were sold in various containers with the prices depending on the quantity in the container. In

Plate 3 Dried alate form of Macrotermes natalensis (termite) on sale in Gboko main market, Benue State

Plate 4: Adults of Brachytrupes membranaceus (crickets) displayed on sticks for sale at Emere near Okaba in Benue State

Plate 5: Termite and Cirta forda snacks for sale alongside native pear, poultry eggs and pork at Mban u Inja market in Gboko, Benue State

Some cases edible insects were prepared in the form of snacks and displayed for sale alongside other meat products like poultry eggs, pork and even fruits of native pear, Dacyodes edulis (Plate 5).

Proximate composition of edible forest insect species in Benue State, Nigeria: Analysis of variance performed for the proximate composition of various edible insect species showed significant difference among the insect species (p<0.05) (Table 2). The dry matter of the adult cricket, Brachytrupes membranaceus, was significantly higher than that of the caterpillars of the emperor moths, Cirta forda, Bunaea alcinoa and the alate cast of the termite, Macrotermes natalensis. Ether extract was significantly more in cricket than in termite and the emperor moths-Cirta forda and Bunaea alcinoa. There was significantly higher level of ash in the termite compared to cricket, C. forda and B. alcinoa. The crude fibre content of the termite was significantly highest
followed by that of cricket, *Cirina forda* and that of *Bunaea alcinoe*. The crude protein contents of the caterpillars of the emperor moths, *C. forda*, *B. alcinoe* were significantly highest followed by termite and cricket. Nitrogen free extract was significantly highest in *Bunaea alcinoe* and least in *Macrotermes natalensis*.

### DISCUSSION

The results of this study have shown that edible insects are prominent items of commerce in Benue State contributing to the socio-economic well-being of the people in both rural and urban communities alike. It also shows that edible insects compete favourably with other meat products in Benue state which explains why they are displayed for sale alongside other meat products like pork and poultry eggs. It is also indicative of the fact that the edible insect species are abundant in Benue State since the quantities are enough to meet household consumption and also for sale. The results of this study tally with those obtained by Mibata and Chidumayo (2003); Fasoranti and Ajiboye (1993) and Aigbidiye and Tyokver (1999) who have reported that edible insects are notable items of commerce in many communities in developing countries playing important roles in poverty alleviation and meeting the protein needs of the people. De Foliart (2002, 1989) had also reported that edible insects contribute heavily in the incomes of the rural populace in many Third World countries.

The dry matter of the adult cricket, *B. membranaceus*, was significantly highest, which means that weight for weight, *C. forda*, *B. alcinoe* and *M. natalensis* have more water content than *B. membranaceus*. This could be explained on account of the more sclerotised exoskeleton present in cricket than in the emperor moths and termite. The cuticle in termite and the caterpillars of the emperor moths is thin and flexible compared to the cricket (Borror et al., 1976). Ether extract is more in cricket than in termite and the emperor moths. This also explains the lesser water content in the cricket mentioned above. This also, shows that the fat content of cricket is more than that of *C. forda*, *B. alcinoe* and *M. natalensis*. The implication of fat content on comparative feeding value is that *C. forda* and *Bunaea alcinoe* would attract more value by virtue of their lower fat content. This result agrees with Taylor (1975) and De Foliart (1991) that some insect species have high fat content compared to others. The significantly higher level of ash in the termite compared to cricket, *C. forda* and *B. alcinoe* could be explained on account of the fact that the termite feeds principally on humus, grass and fungi while *C. forda*, *B. alcinoe* and *B. membranaceus* feed principally on tender foliage.

The higher content of crude fibre in termites could be explained on account of its feeding behavior (preferring woody plants to grasses). Components of crude fibre are mainly structural carbohydrates which are cellulosics and hemicelluloses. Nutritionally the caterpillars of the emperor moths are of higher value followed by the termite based on the crude protein value. The crude protein value of the caterpillars of the emperor moths is comparable to fish (61.1%) in human diet (Ande, 1991; De Foliart, 1991; Cullison and Lowrey, 1987). This result agrees with Cunningham (1996) that over 60% of the dry matter of edible caterpillars is protein. Cricket has the least amount of crude protein. This could be as a result of the high proportion of fat. Fat content is known to be inversely related to crude protein (Cullison and Lowrey, 1987). Nitrogen free extract is normally determined by difference and it is generally low in animal products. Its variability between insect types as observed in this study could be explained on account of other proportions of the different variables analyzed.

### Conclusion and recommendations:

This study sought to investigate the marketability and nutritional qualities of the edible forest insects in Benue State. The study has revealed that edible forest insects are marketed in Benue State with the most marketed being *C. forda* and *B. alcinoe*, *M. natalensis*, *B. membranaceus*. The study showed that edible forest insects are of high nutritive value having as high as 74% crude protein in the pupae of *C. forda* and *B. alcinoe*. Information on the marketability and nutritive value of these insect species in Benue State would reveal their economic value to consumers. In the light of the economic significance of edible insects in Benue State, the following recommendations are made:

The State government should enforce the legislation against bush burning and illegal tree felling to preserve the habitats of these insects. Recently there has been massive exploitation of *Prosopis africana* and *Vitellaria paradoxa* trees for firewood, burnt bricks, bakery etc in the State.

There is need to establish plantations of *V. paradoxa*, *P. africana*, *P. biglobosa* and *Khaya senegalensis* to promote the production of *C. forda* and *B. alcinoe*, which are heavily marketed in Benue State.
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